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Ms. Magalie Roman Salas
Secretary, Federal Communications Commission
445 12th St S.W., Washington, DC 20554

1st February 2001

Notification of Ex Parte Meeting - Docket ET98- 237
Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band

Dear Ms. Salas

Pursuant to the Federal Communications Commission's rules, 47 C.F.R. § 1.1206, this letter is being filed electronically for inclusion in the above-referenced docket and will notify you that representatives of BeamReach Networks Inc and Transcomm Inc met on Wednesday 31st January 2001 with Rodney Conway, Rodney Small, Ira Keltz and Bruce Romano of Office of Engineering and Technology (OET) plus Eli Johnson, Bill Lane, Won Kim and Ron Netro of Wireless Telecommunications Bureau (WTB).

The participants discussed technology and policy developments related to emerging technology for high efficiency / high capacity broadband fixed wireless access systems optimized for residential and small / medium business deployments using limited bands of spectrum as background to the comments / reply comments already submitted by the presenters under the above mentioned proceeding.

We sincerely appreciate the time and interest of the FCC participants and attach hereto a copy of the slides presented at the meeting.

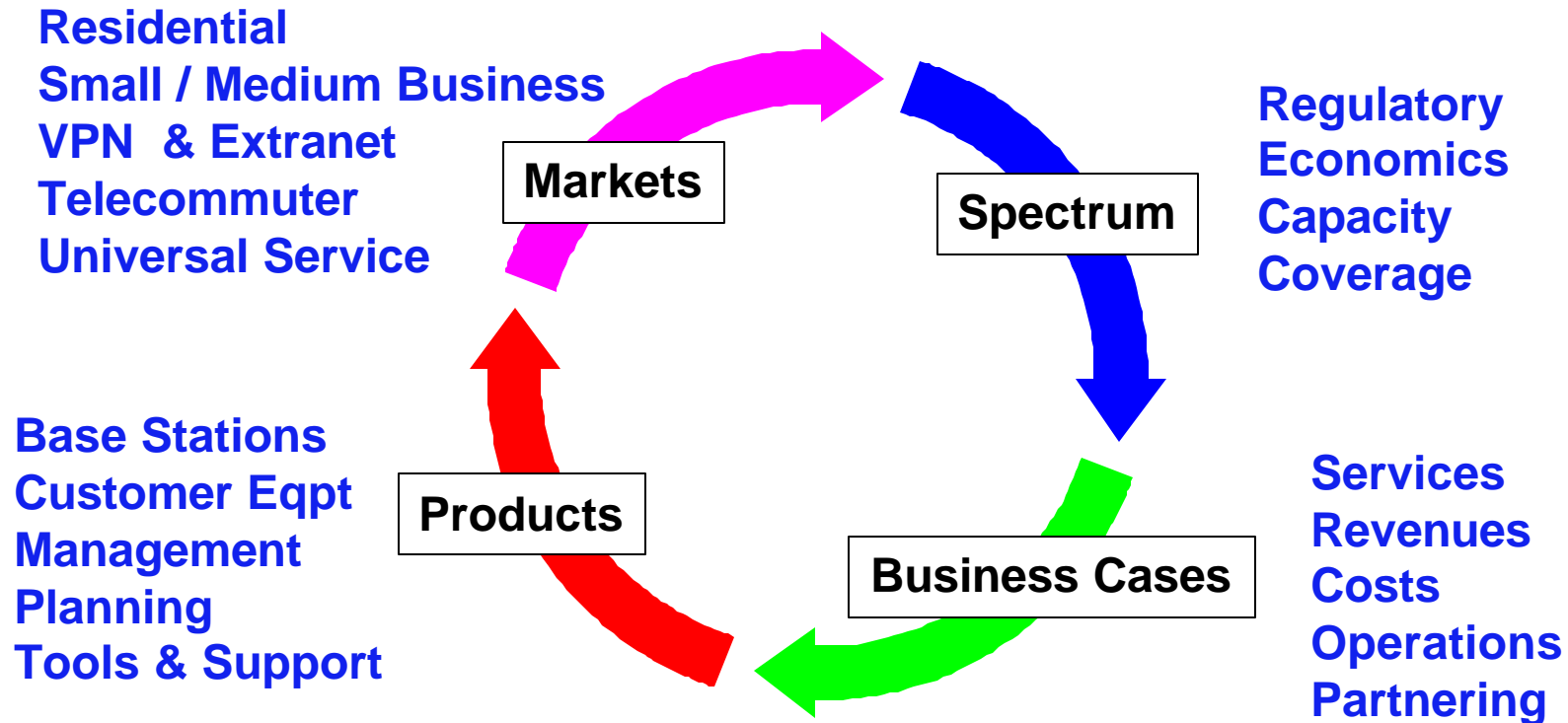
Please direct any questions or concerns to the undersigned.

Respectfully submitted,

/s/ Randall Schwartz

Randall Schwartz
BeamReach Networks Inc.

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Business Case - Technology Perspective

- **2nd Generation “WLL” Unsuitable for Developed Markets**
 - Low capacity, low spectral efficiency and data rates
 - Fundamentally circuit switched or wireless LAN entities
 - High costs for Residential and SME deployments
- **3rd Generation Radios Optimized for Mobility**
 - 384 kbps link rates - not competitive with DSL/Cable
 - Spectral efficiency impacted by mobility support
 - Unable to meet economic and reliability criteria for fixed access
- **LMDS / Millimeter Wave Products too Restrictive**
 - Suitable for businesses where very large bandwidth pipes are required
 - Line-of-sight propagation limits coverage / penetration and impairs economics
 - Technology far too expensive for small business and residence
 - Typical link is \$5,000 to \$10,000
- **Current and Planned MMDS Technology Uneconomic to Deploy**
 - Often Line-of-sight or coverage limited
 - Low spectral efficiency / capacity (e.g., 64 QAM, VOFDM, MIMO)

Business Case - Capacity Perspective

- User data rate ~ 1.5 to 4.5 Mbps to compete with ADSL and cable modem
- Cell radius ~ 5 to 10 miles with > 95% coverage area
- Capacity requirement
 - 500 households/mi² and 10% penetration ==> 4,000 subs/cell
 - 2% duty cycle ==> 120 Mbps/cell
 - duty cycle based on portable business users
 - expected to be much higher for fixed residential users
- Spectral efficiency requirement
 - small allocated bandwidth ~ 10 MHz WCS
 - spectral efficiency requirement ~ 10 bps/cell/Hz

Business Case - Adaptive Multibeam OFDM

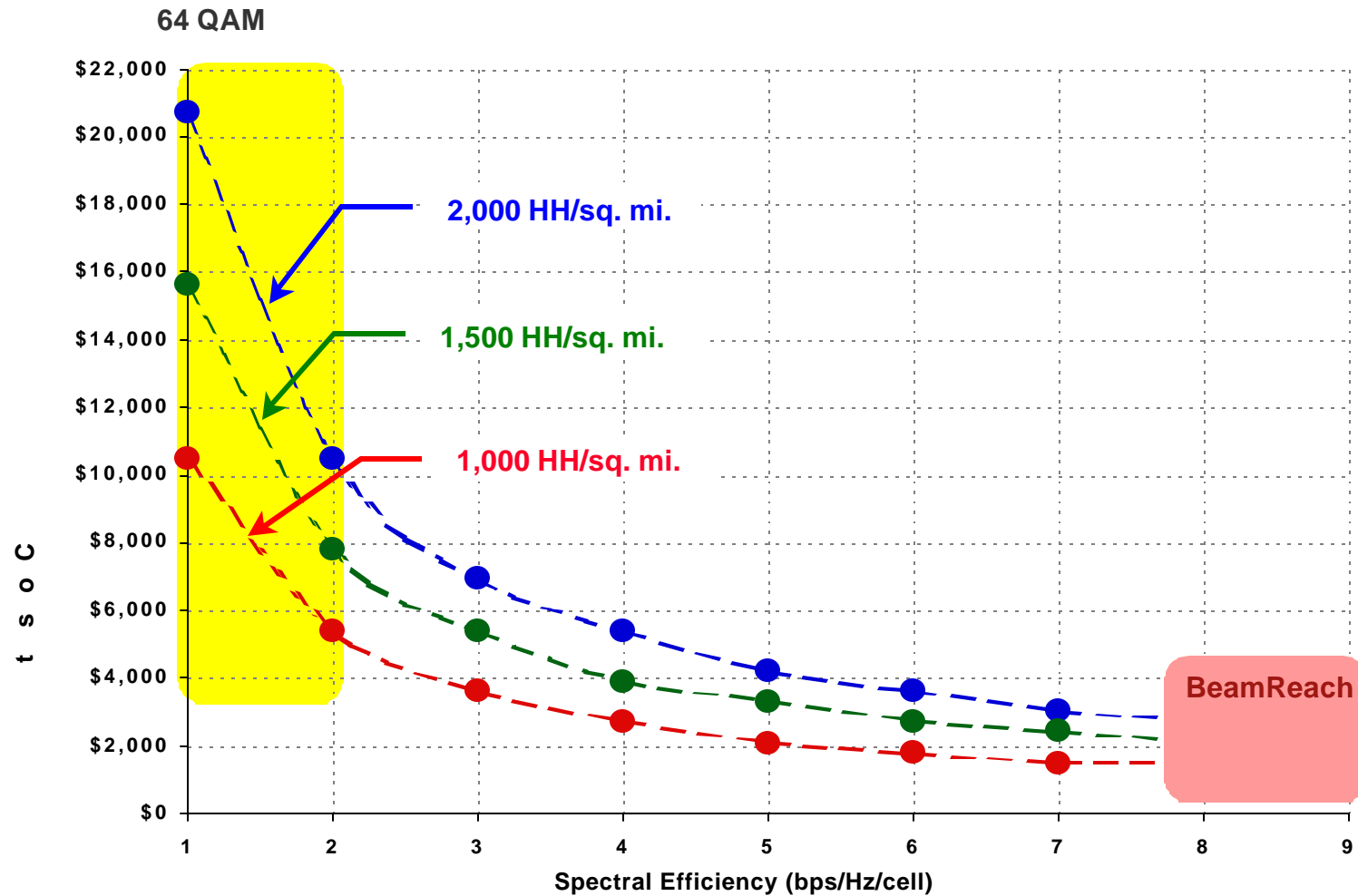
- **New Generation of Digital Radio Technology**
 - Based on technology developed for US Government SIGINT applications.
 - Early version optimized for AT&T “Angel” program (circuit voice, low-speed data)
 - New version optimized for high throughput packet data and voice-over-packet
- **Spectral Efficiency 10 - 16 times Current, 3G & Emerging Radios**
 - CDMA, W-CDMA, 64 QAM, VOFDM, MIMO, etc.
- **Superior Coverage & Propagation Characteristics**
 - Non line-of-sight, high availability, high area coverage
 - Superior link budget, reduced fade margins
 - 4 – 9 times the coverage area of best competitor
 - Advanced interference cancellation, full frequency reuse
 - Tolerant of wideband multipath nulls
- **Scalable, Ultra-high Capacity Architecture**
 - Low cost of coverage in single or multi-cell deployments
 - High subscriber penetrations with modular architecture
 - High link data rates, QOS

Payload Capacity Summary

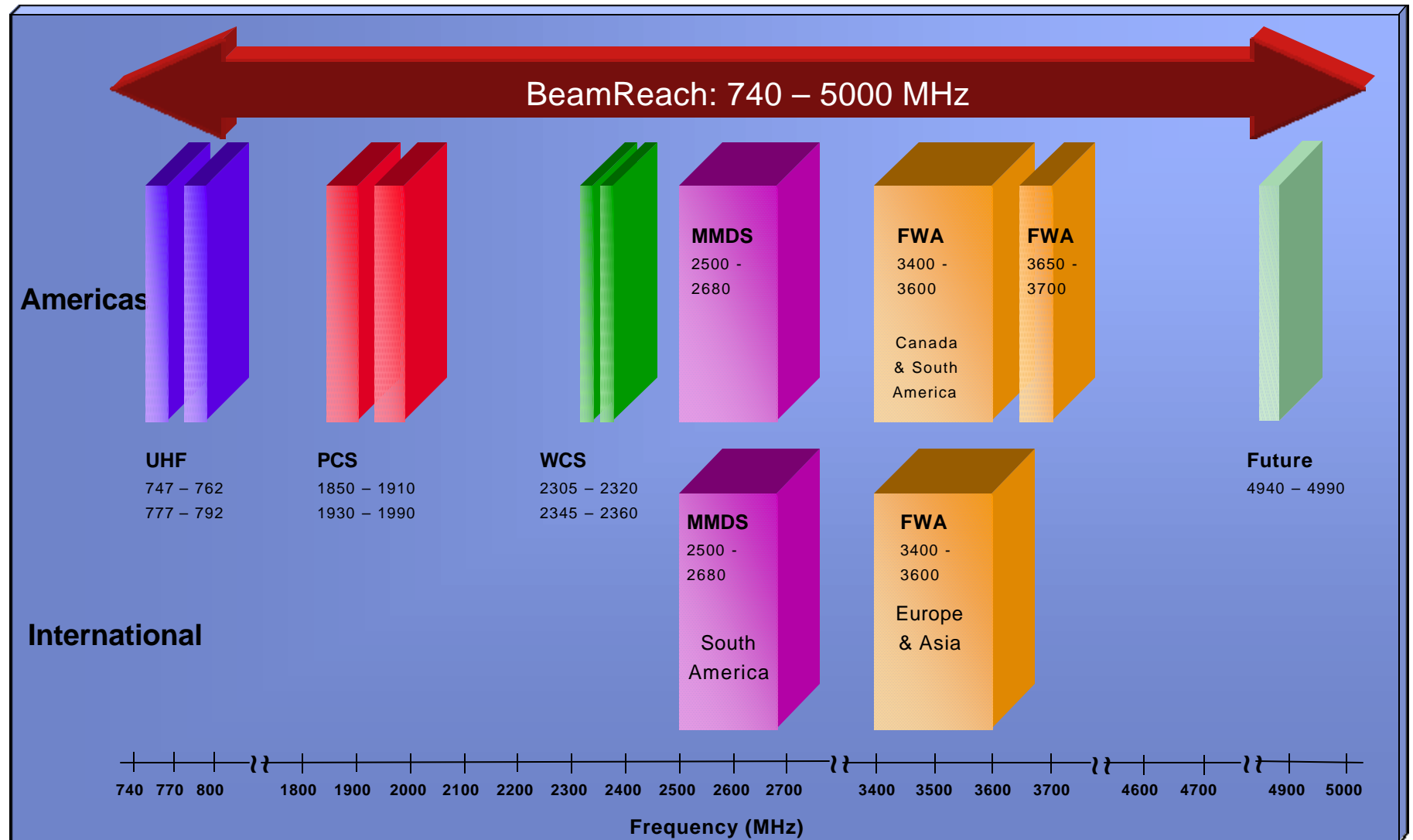
<u>Band Allocation</u> <i>(Paired or Contiguous)</i>	<u>Downlink Payload per Cell</u> <i>(Base Station to Customer)</i>	<u>Uplink Payload per Cell</u> <i>(Customer to Base Station)</i>
5 + 5 = 10 MHz	Supercell : 75 Mb/s Multi-cell : 45 - 55 Mb/s	Supercell : 60 Mb/s Multi-cell : 35 - 44 Mb/s
6.25 + 6.25 = 12.5 MHz	Supercell : 100 Mb/s Multi-cell : 60 - 75 Mb/s	Supercell : 75 Mb/s Multi-cell : 50 - 60 Mb/s
12.5 + 12.5 = 25 MHz	Supercell : 200 Mb/s Multi-cell : 125 - 145 Mb/s	Supercell : 160 Mb/s Multi-cell : 100 - 120 Mb/s
25 + 25 = 50 MHz	Supercell : 400 Mb/s Multi-cell : 250 - 295 Mb/s	Supercell : 320 Mb/s Multi-cell : 200 - 240 Mb/s

Efficiency Impact on Cost

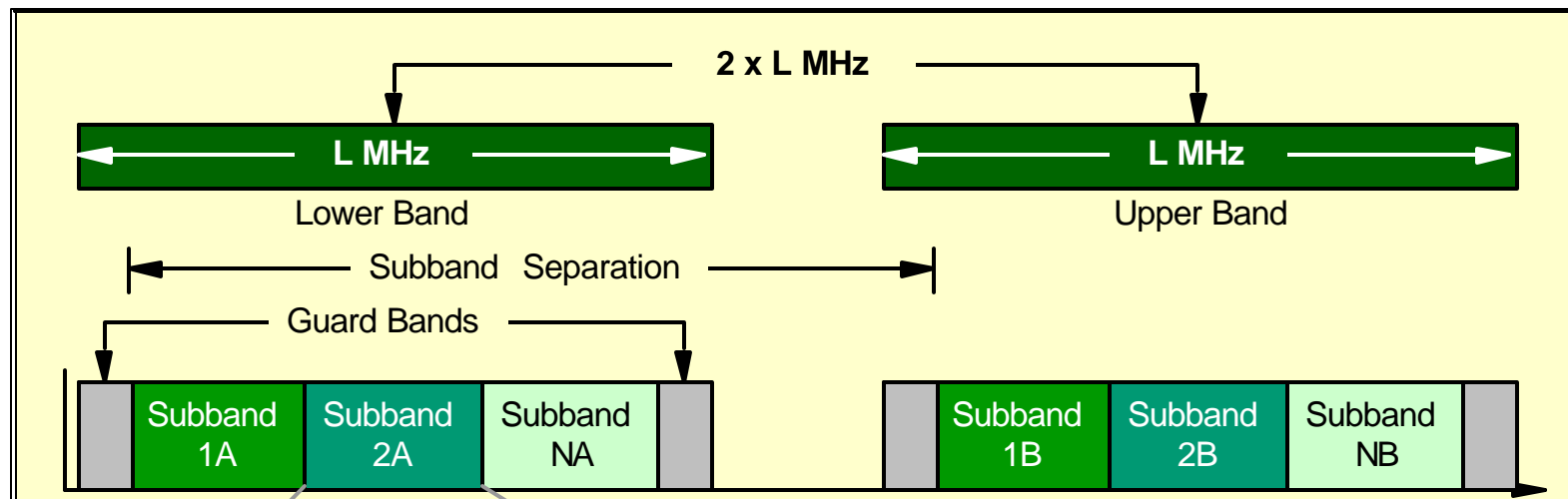
Cost of Base Stations / 400 sq. mi.
(10% Penetration, 25 MHz of Spectrum)



Global Deployment Flexibility



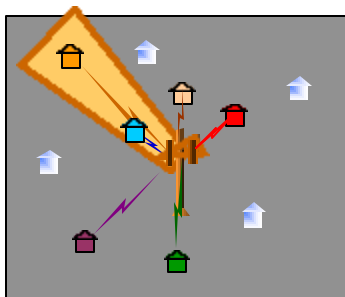
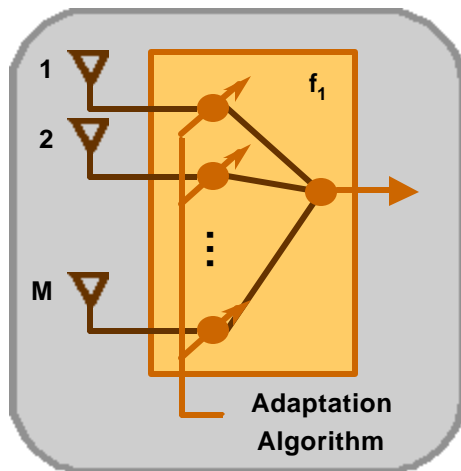
Adaptive Multibeam OFDM Frequency Plan



Integrated Spatial and Spectral Combiner

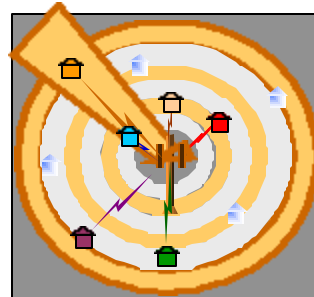
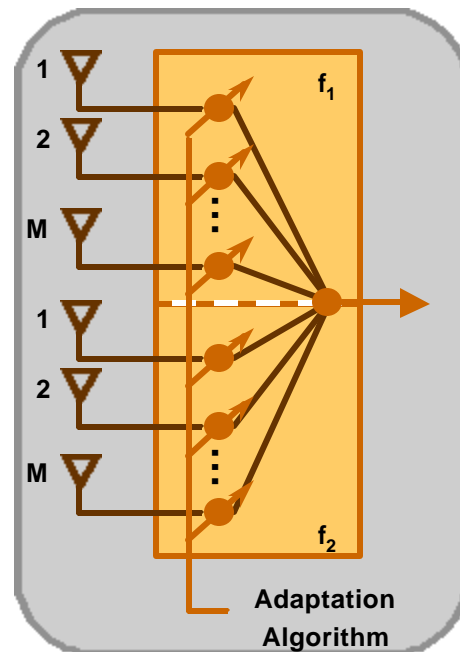
Spatial Beamforming

M antennas \rightarrow
M degrees of freedom

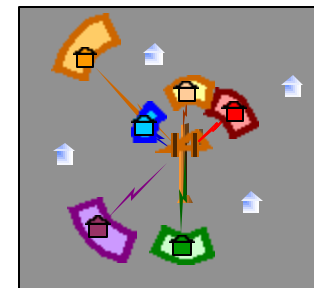
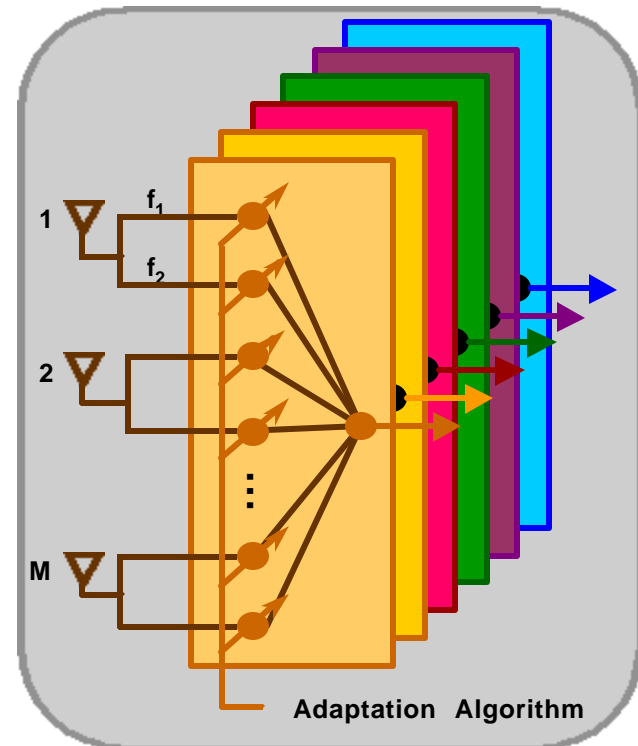


Spatial + Spectral Beamforming

M antennas, 2 frequencies \rightarrow
2M degrees of freedom



Multilink Beamforming



Adaptive Multibeam Coverage Advantages

■ Advantages over sectorized antenna

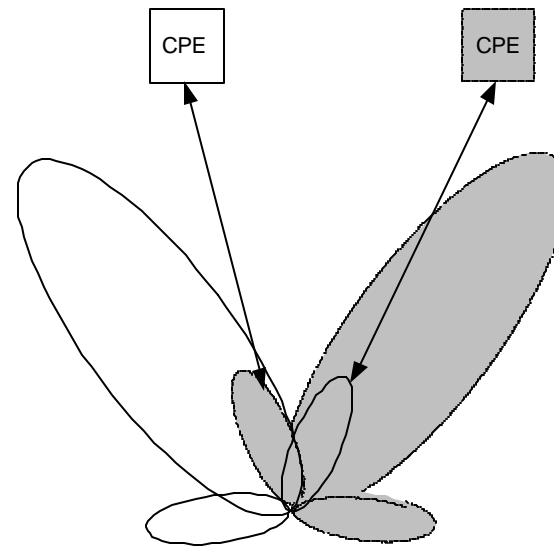
- beam patterns are not fixed
- dynamically creates a beam toward a CPE for a session
 - beam width not constrained by the need to cover a cell
- simultaneously steers nulls toward interferers
- Dramatically increases SNR and SINR

■ Improved SNR and SINR

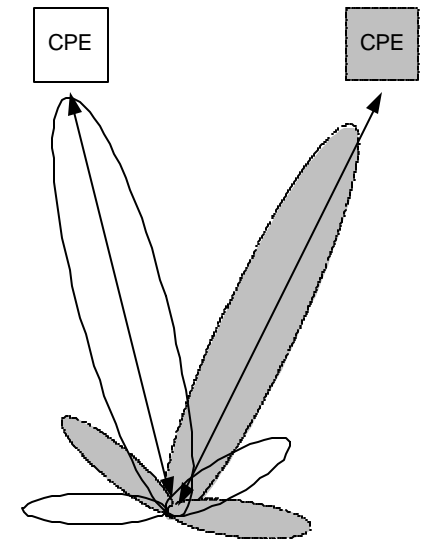
- increased cell radius and improved coverage
- Spatial Division Multiple Access
 - many times frequency reuse within a cell
 - makes even small bands (5-10 MHz) viable

■ Flexible Deployment

- typical deployment wants large range first and the ability to add capacity later
- adaptive multibeam “decouples” range and capacity
 - beam width not constrained by cell coverage
 - scale up capacity by adding processing modules

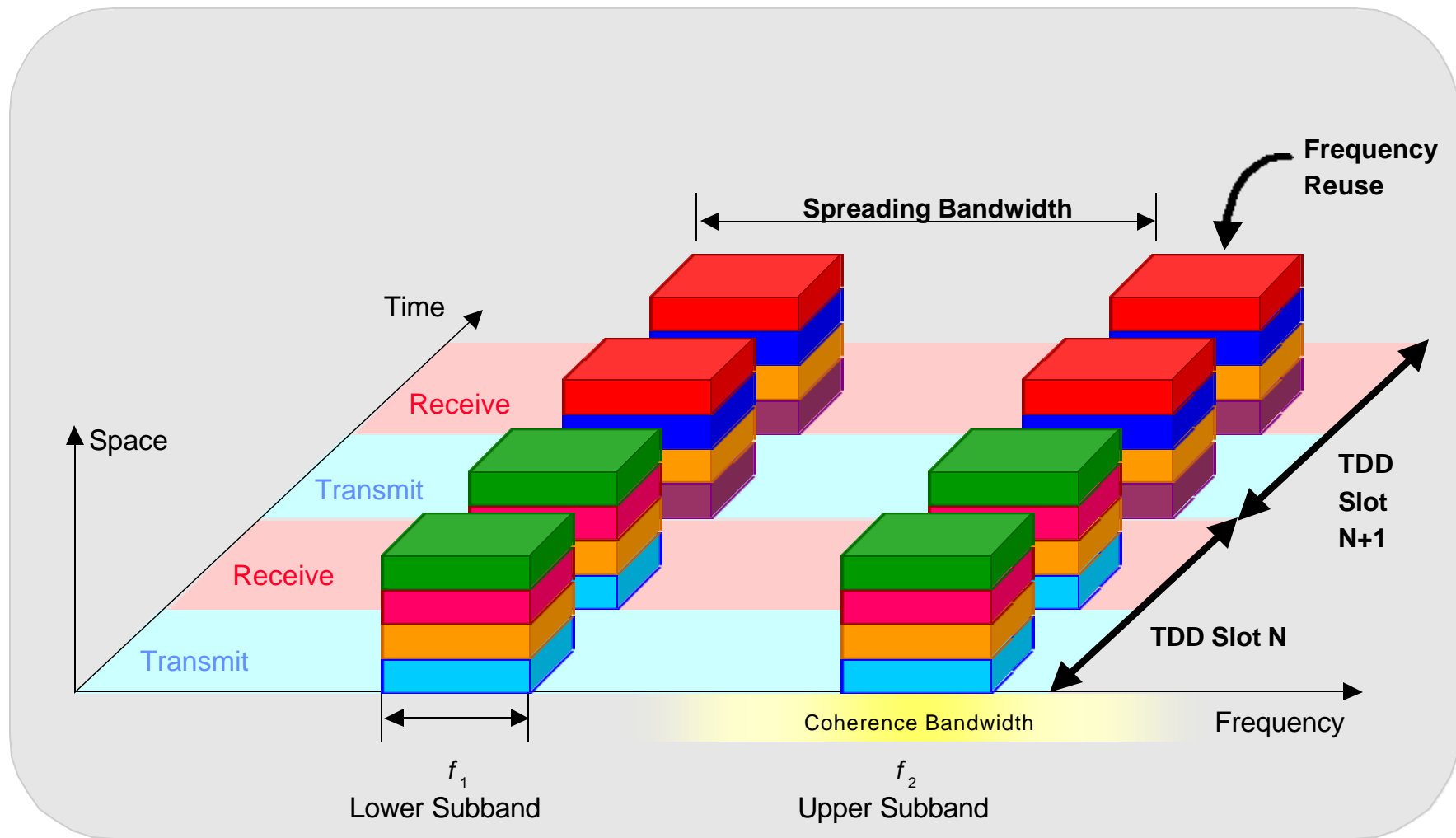


Sectorized Antenna

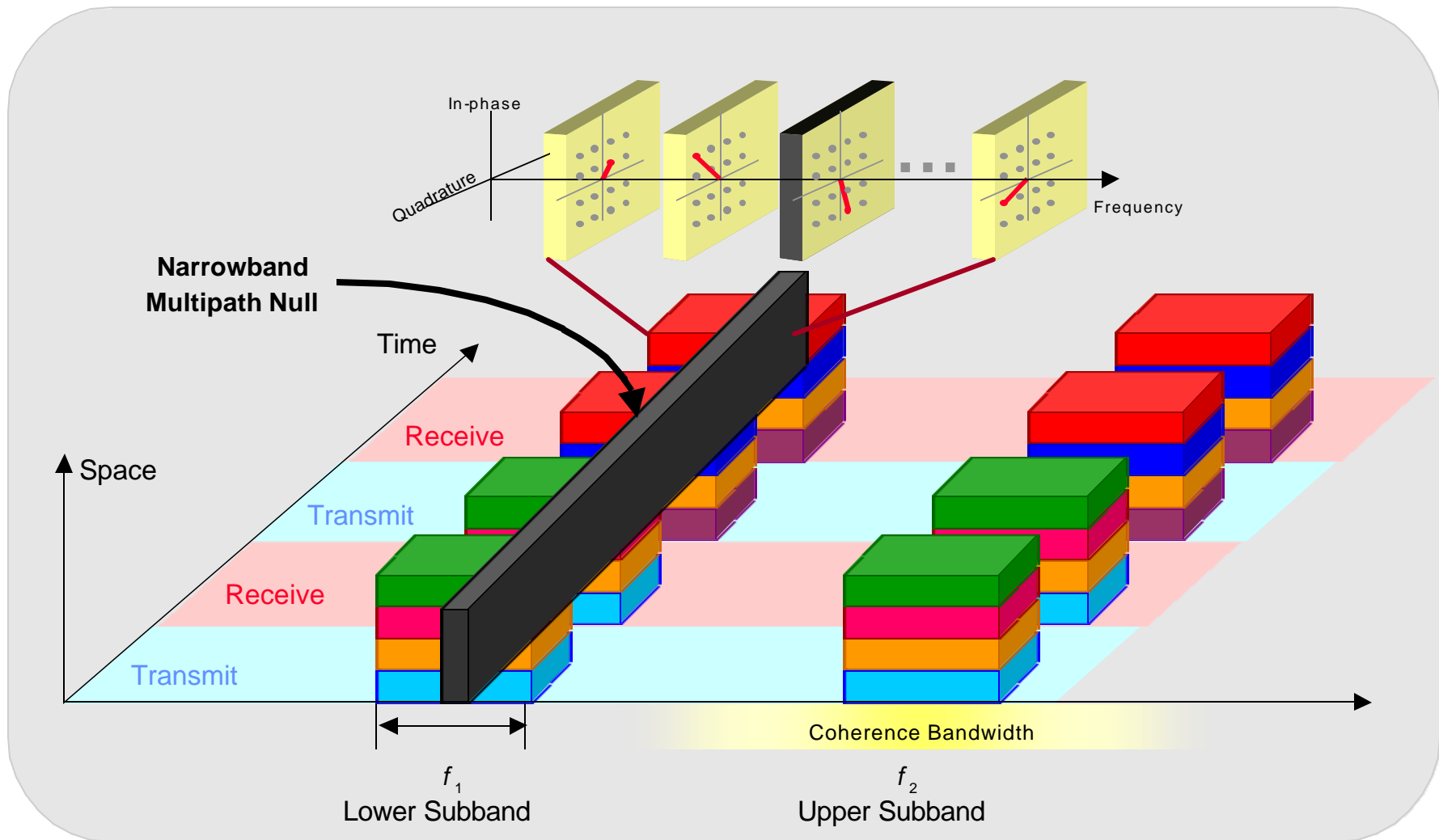


Adaptive Multibeam

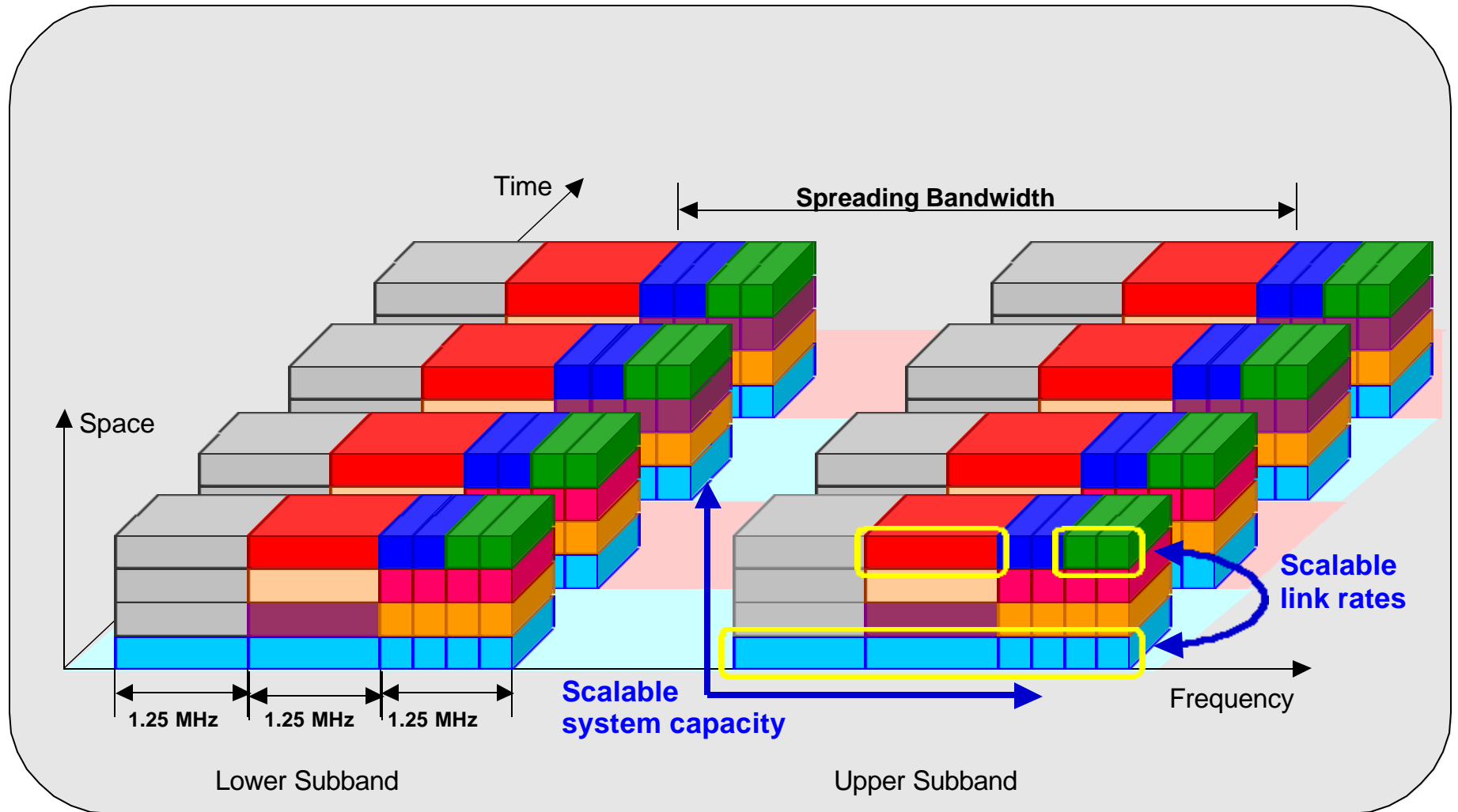
Space/Time/Frequency Layout



Interference & Multipath Mitigation



Scalability



Modular Growth Architecture

SPECTRAL FACTOR		SPATIAL FACTOR						
No of	Typical	(No of Antennae)						
Sub-Band	Band	3		6		9	12	
Pairs	(MHz)*		4		8		12	16
1	3							
2	5							
3	7							
4	9							
5	11							
6	13							
7	15							
8	17							
9	19							
10	21							
11	23							
12	25							
13	27							
14	29							
15	31							
16	33							
* Add 1-2 MHz for Paired Bands plus 1 - 3 MHz for "Restricted" Bands								

Payload Capacity

System Capacities *

Allocated Spectrum	Cell Capacity	Data Subs/Cell (1.5 Mbps)	Voice Subs/Cell (32 kbps)
10 MHz	86 Mbps	5,000	12,300
20 MHz	194 Mbps	11,700	28,700
24 MHz	229 Mbps	13,300	32,800
30 MHz	304 Mbps	18,300	45,000
50 MHz	525 Mbps	31,500	78,000

- Capacity figures are (downlink plus uplink) based on multi-cell deployment in full multipath environments.
- Available capacity is typically 35 – 80% greater in reduced multipath or single cell deployments.

Adaptive Multibeam OFDM Benefits

- **Spectral efficiency up to 16 times competition**
 - Fewer base stations
 - Far lower cost of coverage
 - Faster network build out
 - Reduced time and cost for acquiring and approving antenna sites
 - Supports growth in bandwidth intensive services
 - E.g., streaming audio/video, high bit rate voice
- **Highly scalable solution**
 - Scales with spectrum, antennas
 - Low cost of coverage
 - Capacity (cost) grows with usage (revenue)
 - No cell splitting required
 - Avoid truck roll to realign customer antenna
- **Full frequency reuse**
 - No complex frequency planning and management
 - No inter-cell interference problems

Adaptive Multibeam OFDM Benefits

- **Superior interference cancellation and multipath mitigation**
 - Soft capacity reduction with increased interference and multipath
 - Simplified interference management with neighboring operators
 - Enhanced system trade-offs
 - Increased cell radius – low cost of coverage, fewer siting problems
 - Lower antennas – reduced siting problems
- **Non line-of-sight operation**
 - Improved coverage (98%)
 - Increased addressed market
 - Simplified CPE deployment
- **Flexible link rates**
 - Increased link rates by concatenating OFDM/DMT tones
 - Not bounded by carrier bandwidth